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• Original Article

Evaluation of different types of arsenic methylation and its relationship with metabolic syndrome in an area chronically exposed to arsenic

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Evidence suggests that the relationship between arsenic metabolism and diseases, including metabolic syndrome, is complex. The aim of this study was to evaluate the different types of arsenic methylation and its association with metabolic syndrome in an arsenic endemic area. A cross-sectional study was conducted on 132 subjects from Shahid-Abad Village, Qazvin province, Iran (arsenic endemic area). Demographic characteristics, metabolic syndrome, and urinary arsenic species, including iAs (inorganic arsenic), MMA (monomethylarsonic acid), and DMA (dimethylarsinic acid) were measured for all patients and their relationship was analyzed by appropriate statistical methods. In this study, 34.5% of the participants had metabolic syndrome. The decrease in %MMA, increase in %DMA and increase in secondary methylation index (DMA/MMA) were associated with increased risk of metabolic syndrome ($p<0.05$). We did not find any association between the incidence of metabolic syndrome with primary methylation index (MMA/iAs) and %iAs ($p>0.05$). This study showed that the prevalence of metabolic syndrome was significantly higher in people with metabolic syndrome than in the general population. A closer examination revealed that the secondary methylation index is related to the metabolic syndrome and its components. Given the higher prevalence of cardiovascular disease and diabetes in patients with metabolic syndrome, it is necessary to change the pathogenesis of the disease using comprehensive management methods for decreasing patient complications.

Keywords: arsenic toxicity, metabolism, diabetes, glucose, metabolic syndrome

Introduction

Heavy metals are one of the most important environmental pollutants whose rate of entry into water resources is increasing through agricultural, industrial and urban development activities [1-3]. Among heavy metals the inorganic arsenic (iAs) is a carcinogen that ranks the 20th in terms of frequency of elements in the earth's crust with an average of 1.8 mg/kg. It is naturally found in the oxidation state of AsV (arsenate) and AsIII (arsenite), the latter being about 60 times more toxic than the former [4].

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The biotransformation pathway of As involves several changes in oxidative state, oxidative methylation, and production of at least four metabolites. When this metalloid enters the body, iAs is metabolized from arsenate to arsenite and then metabolized by oxidative methylation to monomethyl arsenic (MMA). After the conversion from arsenate to arsenite, at the final methylation stage, dimethylarsinic acid (DMA) is produced [5, 6]. After exposure to arsenic, 40-60% of absorbed arsenic is eliminated by urine. Biological monitoring of arsenic exposure has been carried out for many years based on the determination of methylated metabolites, DMA and MMA, in urine [6].

This toxic metalloid is associated with an increased risk of complications, including cardiovascular consequences. Arsenic exposure is also related to the diagnosis of metabolic syndrome [7,8]. Metabolic syndrome is associated with a number of risk factors including abdominal obesity, hypertension, high triglycerides, and low high-density lipoprotien (HDL)